Cape Breton Oyster (Crassostrea virginica)
Seed Stock:
Exposure to Malpeque Disease Under
Field Conditions on the Eastern Shore

by

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Introduction

It has been recognized for some time that the major factor limiting the expansion of the oyster industry in Nova Scotia is the lack of a dependable supply of seed oysters (approximately 35 mm in size) for both the public beds and private leases (Morse, 1971). This situation is the result of a combination of adverse environmental and man-made factors. Morse (ibid.) proposed three main reasons for this scarcity: 1) the Maritimes delimit the northern range of the American oyster (Crassostrea virginica), which results in certain marginal environmental conditions being encountered, affecting reproduction, survival, and growth of young oysters; 2) difficulty and delay has been experienced in the reestablishment of oyster stocks in some areas ravaged by disease; and 3) those involved in the commercial harvest have failed to take advantage of new seed production technology, such as raft culture and hatchery seed production. To this we can also add the aggravating impact of industrial pollution on oyster beds, including greatly increased sedimentation - the result of changing agricultural practices.

To date, the situation remains relatively unchanged in the oyster producing areas of mainland Nova Scotia, i.e. the Northumberland Strait and St. Georges Bay areas. In the other major producing section of the province, the Bras D'Or Lake area, the situation has noticably improved. Beginning in 1971, the Cape Breton Development Corporation (DEVCO), thrcugh it's subsidiary company, Cape Breton Marine Farming Limited (CBMF), began a pilot scale study of the production of seed oysters on artificial substrates, i.e. strings

of scallop shells suspended from floating rafts. This technique proved successful, with good spatfall being obtained in four of every five years (R. Stuart, personal communication), and led to expansion of the project to commercial scale seed production at Portage Creek. By 1979, this operation achieved a level of seed production in excess of the immediate needs of Cape Breton oyster growers and CBMF began investigating the feasibility of marketing this excess (2-3 million seed annually) to growers on the mainland (R. Stuart, personal communication). The greatest foreseeable obstacle to this was the known susceptibility of Cape Breton oysters to Malpeque disease.

This disease was so named because it was first noted in 1915 in Malpeque Bay, PEI where it caused heavy mortalities. By 1955 it had spread to the mainland areas and by 1960, oyster stocks in mainland Nova Scotia had been virtually destroyed. The only area which remained unaffected was Cape Breton. More detailed descriptions of the spread of this disease and the rehabilitation of stocks using resistant Malpeque oysters were given by Needler (1947), Logie (1956), Logie, Drinnan and Henderson (1960), and Medcof (1961). The Cape Breton oyster stocks, not having been exposed to the causative agent of Malpeque disease, did not suffer the high mortalities, nor did they develop any resistance to the disease as did the residual PEI and mainland oysters. Test introductions of Cape Breton oysters into Malagash during the early 1960's demonstrated that the disease agent was still active in that area and that the oysters were highly susceptible. Mortalities ranged from 65-93% (Drinnan and England, 1965).

The susceptibility was also documented by MacLeod (1972) on Cape Breton oysters introduced to Pleasant Point Pond, Halifax County, in 1969. Mortalities among the tray-held Cape Breton oysters had reached 95% by 1972, while in adjacent trays the resistant strain of Malpeque oysters suffered only 5% mortalities.

A discovery which both these trials made was the occurrence of a lag time of at least one year between the stock transfer date and the onset of disease-related mortalities. The marketing plan proposed by CBMF hoped to take advantage of this fact by providing mainland growers with large bedding oysters (approximately 50mm) in April or May which might then reach minimum market size (76mm) in two summers, prior to the onset of mortalities. In order to test this proposal, representative samples of bedding seed were sent to two grow-out sites on the mainland, one lot to East River, Pictou County, and the other to the Nova Scotia Department of Fisheries test site at Pleasant Point, Halifax County. The present report is a summary of the results of the Pleasant Point trial.

Materials and Methods

In June 1979, two crates of Cape Breton oyster seed (1977 year class) were received at Pleasant Point. The seed was immediately cleaned of excess mud and empty shells using a moderate pressure water spray. It was then separated into two lots: those individuals of minimum market size or greater, and those smaller. The two groups were placed on separate mesh trays and suspended in the water column at 0.7 m depth. The trays used were of Pleasant Point design consisting of a galvanized iron frame covered with polypropylene mesh, with

dimensions 226 x 104 x 10 cm. The seed remained on these trays for 26 days which allowed sufficient time for manifestation of any after-effects of harvesting, transport, and cleaning such as mortality of badly damaged oysters or healing of less badly damaged shells.

On July 20, 1979, both lots of seed were removed from the trays and a proper evaluation and enumeration was carried out. Both groups were then returned to the trays for ongrowing. Densities used were 180 oysters/m^2 for the market seed and 172/m^2 for the submarket seed. Densities on both trays were well below the 417/m^2 recommended by MacLeod (1972) for favorable growth of comparably sized seed. This procedure was repeated three times in the course of the study on the submarket oysters only. It was assumed the larger oysters would have been marketed and not relayed. Monthly throughout the duration of the test, the seed was transferred to clean trays to avoid excessive bio-fouling of the mesh openings. At each change, random grab samples of five or six oysters were removed from the group of larger oysters and examined for signs of weakness. These were then opened and a visual examination performed on the meats to determine relative fatness and to check for any obvious signs of illness. Occasionally larger samples were removed from this tray for condition index determination, calculated as (from MacLeod, 1972)

$$\frac{\text{dry weight of meat (gms)}}{\text{shell capacity (gms)}} \times 1000.$$

Temperature and salinity were monitored throughout the test period, using a Beckman salinometer model RS5-3.

Results

Temperature and salinity graphs for the test period 1979 and 1980 are given in Figures 1 and 2.

The first measurement was conducted on July 20, 1979. At that time, from a total of 861 oysters, there were 14 mortalities (1.6%). Of the 847 live animals, 433 (50.3%) were found to be of minimum market size or greater. The remaining 414 (48.1%) were less than 76 mm and were returned to the trays for ongrowing. The meat condition index was found to be 62.5. This is acceptable for bottom grown oysters (Table 1).

Growth: Growth of the smaller oysters during the summers of 1979-1980 resembled that reported by MacLeod (1972) for similiarly sized Malagash oysters at Pleasant Point (Table 2, Figure 3). At the November 2, 1979 examination, it was determined that an additional 49 oysters (5.7% of total) had attained market size. Growth was interrupted by winter dormancy from December to April. Condition index determination in March 1980, approaching the end of the dormancy period, showed the oysters to be in very good condition (Table 1). By July 1980, 47 more oysters, representing 5.5% of the total group, had reached minimum market size. Table 3 shows a summary of the number and percentage of oysters which attained market size prior to the onset of disease-related mortalities. No obvious weakness or meat abnormality was reported at the July 21, 1980 examination.

Mortality: Summaries of the mortality data are presented in Table 4 and Figure 4. The "actual" figures represent the mortalities which occurred within the submarket group, including those oysters

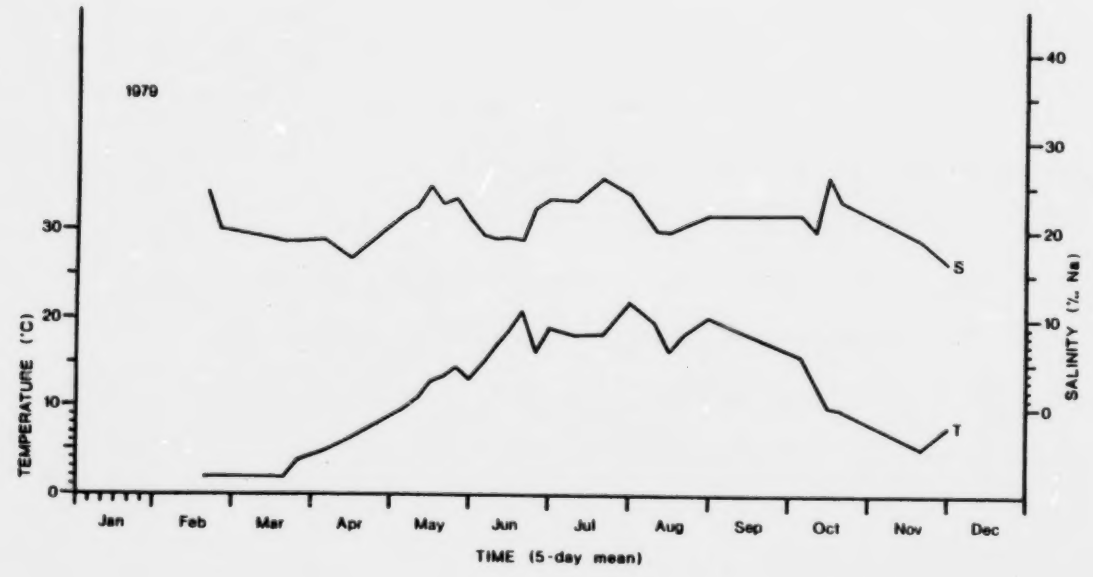

Figure 1. Temperature and salinity graphs for 1979 at Pleasant Point Pond. Note: Data was collected basically daily from May through August, and intermittently at other periods of the year. The graphs presented indicate the means for each 5-day period.

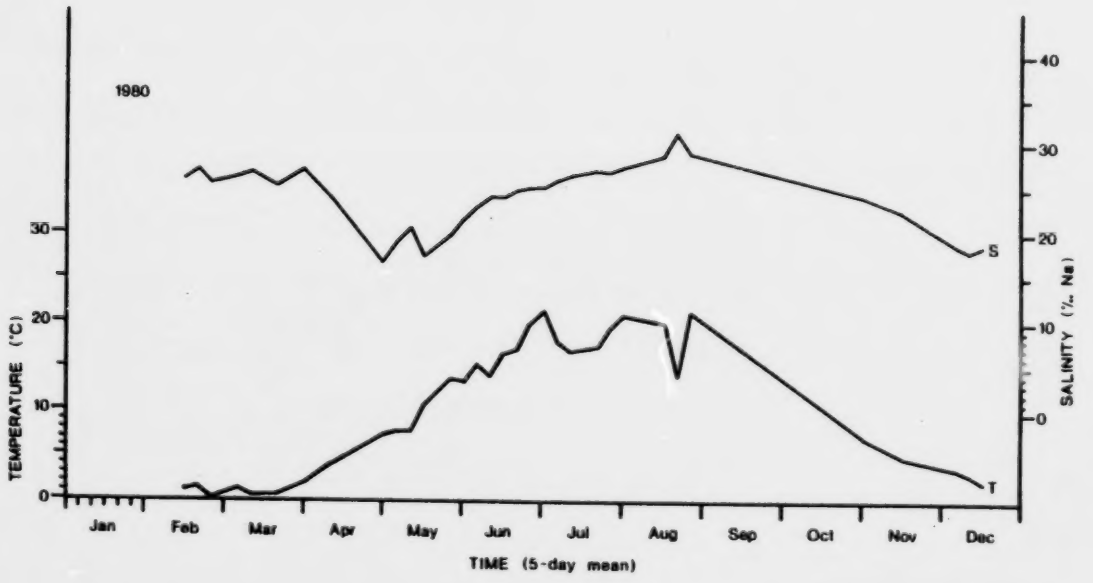

Figure 2. Temperature and salinity graphs for 1980 at Pleasant Point Pond. See note in Figure 1 caption.

Table 1. Condition indexes of oysters raised in this 1979-1980 trial and in a 1972 trial.

	Condition Index
1979-1980 trial:	
July 1979 mean	62.5
March 1980 mean	103.6
MacLeod (1972) trial, for comparison:	
Tray-grown oysters	103-118
Bottom-grown oysters (very good quality)	85

Table 2. (A) Growth data for Cape Breton submarket oysters at Pleasant Point, 1979-1980. (B) Growth data for Malagash oysters at Pleasant Point (from MacLeod, 1972).

(A)

Date	Mean Length (mm)	Standard Deviation (mm)	Increment (mm)
July 20, 1979	57.6	10.8	-
November 2, 1979	64.0	11.4	6.4
July 21, 1980	69.3	11.7	5.3
September 12, 1980	73.5	13.8	4.2

(B)

Stock	Number of Samples	Mean Size (mm) June 1971	Mean Size (mm) October 1971	Increment (mm)
Malagash	4	58.4	65.0	6.6
Malpeque	4	75.3	83.2	7.9
Malagash	4	64.6	70.3	5.7

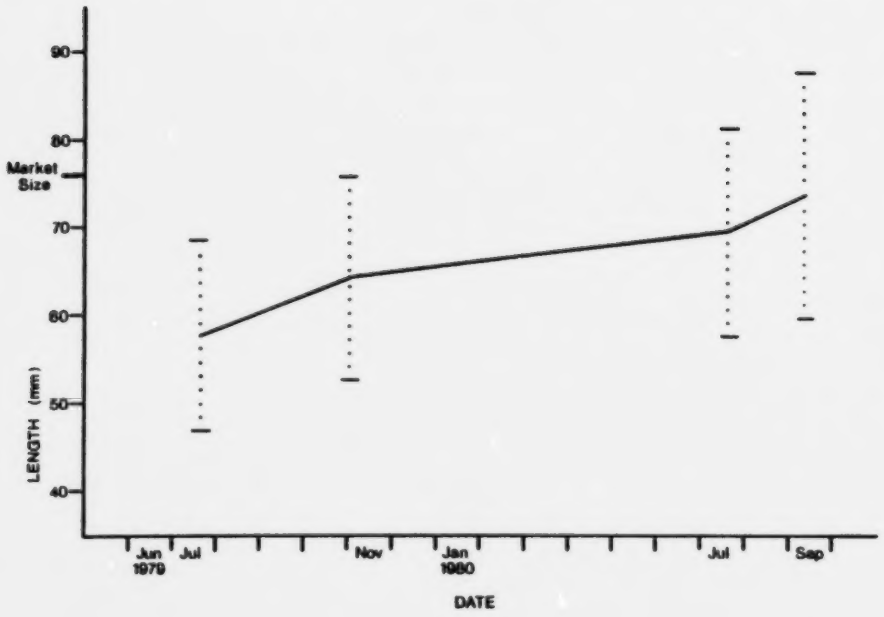

Figure 3. Growth curve of Cape Breton oyster seed, from July 20, 1979 to September 12, 1980, using data in Table 2(A). Curve shows mean lengths plus standard deviations at specific dates.

Table 3. Summary of the number and percentage of oysters which attained market size (≥76 mm) prior to the onset of disease-related mortalities. Initial sample size was 861.

Date	Number	Percentage of Initial Sample
Initial (July 1979)	433	50.3%
November 1979	49	5.7%
July 1980	47	5.5%
Totals	529	61.4%

Table 4. Summary of mortality data for the submarket group. "Actual" figures represent all mortalities which occurred, including those of oysters which attained market size after the initial measurement. "Corrected" figures represent the mortalities which would have occurred had all marketable oysters been removed from the trays when they reached 76 mm.

Date	Number of live Oysters Remaining	Actual Data			Corrected Data		
		Number of Mortalities	Percentage of Initial Number	Cumulative Percentage	Number of Mortalities	Percentage of Initial Number	Cumulative Percentage
Initial (June 1979)	428						
July 20, 1979	414	14	3.3	3.3	14	3.3	3.3
September 11, 1979	414	0	0.0	3.3	0	0.0	3.3
November 2, 1979	381	33	7.7	11.0	32	7.5	10.8
April 11, 1980	363	18	4.2	15.2	15	3.5	14.3
July 21, 1980	357	6	1.4	16.6	6	1.4	15.7
September 12, 1980	146	211	49.3	65.9	113	26.2	41.9

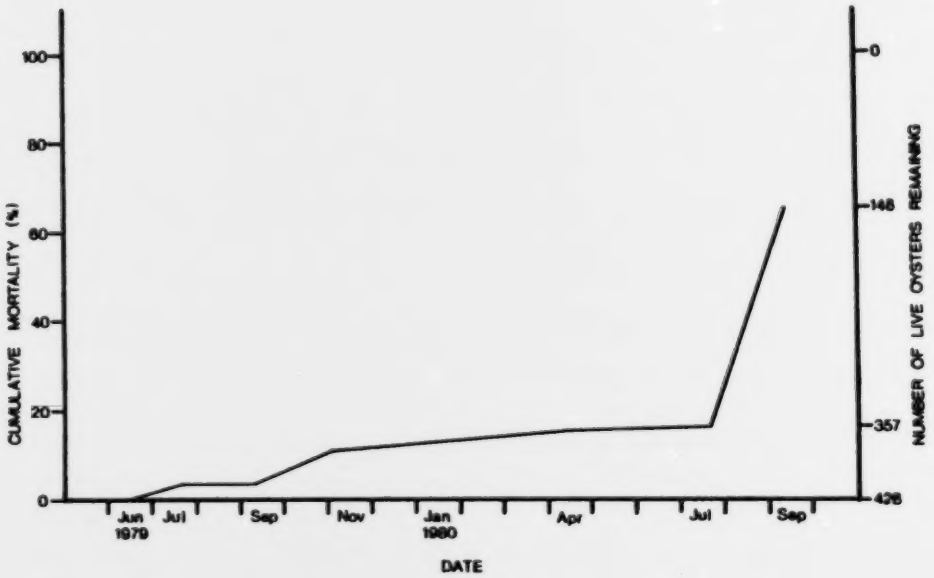

Figure 4. Cumulative mortality curve for Cape Breton submarket oysters from June 1979 to September 1980, using data in Table 4. Curve simultaneously shows percentage of accumulated mortality and number of live oysters remaining at specific dates.

which attained market size after the initial measurement. The "corrected" figures indicate the mortalities which would have occurred had all marketable oysters been removed from the trays when they reached 76 mm.

Mortality up to July 21, 1980 was substantially higher than the rate normally encountered at our site. Losses among other stocks such as Malpeque and Malagash, generally vary between 1% and 5% annually. The exact cause of the 11% loss suffered during the first summer was not determined; however, a portion of this was undoubtedly attributable to damage incurred during harvesting, handling, and perhaps somewhat to transfer stock.

Routine examination of the trays on September 12, 1980 revealed 211 dead oysters. Closer examination showed the remaining oysters to be in varying stages of degeneration. In many, the meat and adductor muscle were completely absent indicating that death had occurred a week or more earlier while others were partially gaping with most of the meat intact. Samples of moribund oysters were provided to Roy Drinnan, Aquaculture Coordinator of Fisheries and Oceans, for examination. Tentative diagnosis indicated that the problem was a classic Malpeque disease outbreak as described by Logie (1956), Logie, Drinnan and Henderson (1960), and Medcof (1961).

Given the high mortality and obvious poor condition of the remaining oysters, the decision was made to discontinue the test at this point.

Discussion

Although the oysters grew throughout the summers of 1979 and 1980, a high proportion of them did not attain minimum market size prior to the onset of disease. Table 5 summarizes the overall findings to July 21, 1980.

It was concluded that July 1980 was the latest possible harvest date for those oysters having attained market size. Although nothing was reported at the July examination to indicate the oysters were in trouble, subsequent mortalities over the following six weeks (49.3%) indicated that the disease must have been well established at that time. The initial size of seed which could have reached market size in the allotted time of the test can be estimated (Figure 5). This can be done by making a best-fit-by-eye plot of the growth data in Table 2, and by running a separate parallel line to zero from the point of intersection of the cut-off points for minumum market size (76 mm) and maximum number of growing weeks (37, to July 1980). From this it can be seen that oyster seed of at least 63 mm shell length would be needed. It would seem illogical that seed of this size would be sold, as very little ongrowing would be needed to produce a market size oyster of higher value.

The results of this test were indicative of near ideal conditions for growth and survival of oysters. The greatly increased meat condition index substantiates this premise. If a similiar transfer was made to a traditional bottom culture operation, the overall results would undoubtedly be altered, presumably for the worse. Losses to predators, siltation, inefficiency of harvesting, physical damage from harvesting, and a reduction in growth rate would decrease the

Table 5. Summary of the findings from June 1979 to July 21, 1980, based on data in Tables 3 and 4.

	Number	Percentage
Total Group (861 oysters)		
Marketable	529	61.4
Mortalities (Actual)	71	8.2
Remaining	261	30.3
Submarket Group (428 oysters)		
Marketable	96	22.4
Mortalities (Actual)	71	16.6
Remaining	261	61.0

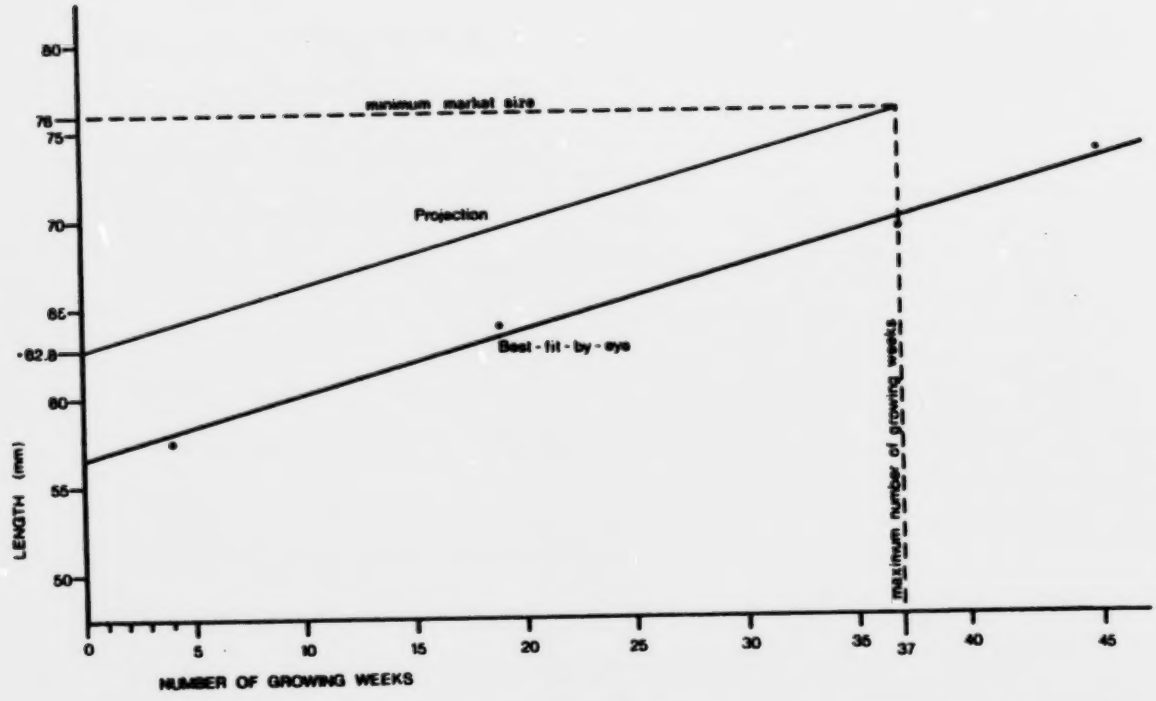

Figure 5. Projection of minimum seed size required to produce market size oysters in 37 weeks. Best-fit-by-eye plot generated by using data in Table 2(A). Number of growing weeks excludes dormancy period of December 1 to April 15 (19 weeks).
*Approximately 63 mm.

overall survival and percentage to market.

In view of these results, it would seem justifiable to conclude that the purchase of seed oysters from Cape Breton, which are susceptible to Malpeque disease, is not a viable alternative for mainland oyster growers.

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